Mechanical Solutions, Inc.
Engineering Analysis, Test & Technology

Prognosis Systems

A NEW DIRECTION IN MAINTENANCE SYSTEMS

as viewed by MSI

using AUTOMATED INTERROGATION AND RELIABILITY OPTIMIZATION (AIRO)

1719 Route 10 East, Suite 205, Parsippany, New Jersey 07054
Tel: (973) 326-9920 Fax: (973) 326-9919
Email: msi@mechsol.com Website: www.mechsol.com

AIRO Methodology

Mechanical Solutions, Inc.
Engineering Analysis, Test & Technology

- ***Automatic interrogation***
- ***Analysis consistent with Failure Modes & Effects***
- ***Analysis calibrated with test, passive data & active inquiries***
- ***Data extrapolated to predict future behavior***
  - Rational: pre-programmed knowledge-base
  - Intuitive: adaptive learning
- ***Proven statistical methodology to optimize of reliable required behavior***

AIRO Methodology

Mechanical Solutions, Inc.
Engineering Analysis, Test & Technology

1. *Formulate "Life Maximization" as an optimization problem that incorporates uncertainty*
2. *Automated interrogation to feed optimization algorithm*
   - *Real-time data from sensors*
   - *Simulations from deterministic analysis codes*
   - *Reference to available databases*
3. *Maximize life by solving optimization problem*
   - *Simulated Annealing/Adaptive Response Surface Method Optimization Algorithm*
   - *Multidisciplinary, nonlinear, stochastic*
   - *Avoid local minima by probabilistically sampling design space*

Prognostics Example at MSI

Mechanical Solutions, Inc.
Engineering Analysis, Test & Technology

Problem:

- ***Turbine engine***

Solution:

- ***Collected passive & active data***
- ***Organized natural frequencies***
- ***Applied MSI solution- Conducted failure mode analyses***

Benefit:

- ***Allowed full load operation***
- ***First day's improved operation paid for analysis and testing***
- ***Prevented catastrophic failure***